Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (withdrawn): A scanning evanescent microwave microscope, comprising:

a scanned evanescent microwave element comprising a resonating cavity having an aperture in an electrically conducting endwall and having a center conducting element comprising a tip that extends through the aperture beyond the endwall to form said tip;

frequency measuring means electrically coupled to said tip, for measuring an initial and a final resonant frequency of the resonating cavity, called a frequency shift;

energy measuring means electrically coupled to said resonating cavity for measuring an initial and final ratio of electromagnetic energy dissipated and stored in said resonating cavity, called a Q shift;

a computing element operative to calculate a dielectric constant and a loss tangent for a material placed near said tip in response to said measured frequency shift and Q shift; and

means for holding said material relative to said tip, said holding means being controlled by a stepping motor having nanometer stability.

2. (withdrawn): The scanning evanescent microwave microscope of claim 1, wherein the scanned evanescent microwave element is a scanned evanescent microwave probe.

3. (withdrawn): The scanning evanescent microwave microscope of claim 1, further including a feedback element for controlling the distance between the tip and the material.

4. (withdrawn): The scanning evanescent microwave microscope of claim 3, wherein said feedback element controls tip-sample distance and its relation to dielectric constant according to the following model equation:

$$C_r = 4\pi\varepsilon_0 R \frac{\ln(1-b)/b+1}{\exp\{G(\varepsilon)[\ln a' - x_0(\varepsilon)]\}+1}$$

5. (withdrawn): A method of regulating the distance between a tip of a scanning evanescent electromagnetic wave microscope and a conducting sample being scanned comprising,

a) selecting a preferred distance, g_p, between said tip and sample;

b) determining a reference resonant frequency f_0 of said tip by:

locating said tip far enough away from said sample material that it is not influenced by said sample;

sweeping a frequency range;

plotting frequency versus power;

fitting a curve to find the maximum frequency, called f_0 ;

c) determining Q_0 by dividing f_0 by the frequency difference at two half power amplitude points;

d) calibrating the geometric factors C and R_0 in equations 1 and 24 by measuring and fitting the frequency and quality factors as functions of a gap distance, g, between the probe tip and a reference sample of known conductivity;

e) measuring the resonant frequency and obtaining the absolute difference between it and the reference frequency;

f) calculating the change in gap distance required to return the gap distance to g_p;

g) electromechanically adjusting the distance between the probe tip and the sample being scanned to equal g_p; and

h) repeating steps e) through g) at a set interval period until the scanning process is complete.

6. (withdrawn): A method of regulating a distance between a probe tip of a scanning evanescent electromagnetic wave microscope and a dielectric sample being scanned comprising,

a) selecting a preferred distance, g_p, between the tip and sample;

b) determining a reference resonant frequency f_0 of the probe by locating the probe far enough away from the sample material that it is not influenced by the sample;

sweeping a frequency range;

plotting frequency versus power;

fitting a curve to find the maximum frequency, called f_0 ;

c) determining Q_0 by dividing f_0 by the frequency difference at two half power amplitude points;

d) calculating the coefficient c from the equation $c = \frac{A_0 f_0}{Q_0}$

where A_0 is the power at f_0;

e) calibrating the geometric factors C and R_0 in equations 1 and 18 using a sample of known dielectric constant;

f) vibrating the sample so as to vary the gap distance, g, between the tip and the sample, wherein the vibration amplitude is small such as that caused by a piezo-electric element and wherein the frequency of vibration is within the frequency difference of element c) above;

g) measuring an averaged shift in resonant frequency and a first harmonic intensity;

h) solving equations 43 and 44 for g; the dielectric constant and the loss tangent;

i) calculating the change in gap distance required to return the gap distance to g_p;

j) electromechanically adjusting the distance between the probe tip and the sample being scanned to equal g_p; and

k) repeating steps e) through g) at a set interval period until the scanning process is complete.

7. (withdrawn): A method for using a scanning evanescent microwave probe to determine electrical properties of a sample, said probe having a tip extending from a coaxial or transmission line resonator, comprising:

measuring variation in resonant frequency and quality factor of said resonator resulting from interaction of said tip and said sample.

8. (withdrawn): A method as recited in claim 7, wherein said measuring of said variation in resonant frequency and quality factor of said resonator comprises:

obtaining signals from an I/Q mixer; and

determining resonant frequency and quality factor as a function of said signals from said I/Q mixer.

9. (withdrawn): A method as recited in claim 7, wherein said tip-sample interaction appears as equivalent complex tip-sample capacitance.

10. (withdrawn): A method as recited in claim 9, wherein said effective complex tip-sample capacitance, $C_{tip-sample}$ is determined according to $C_{tip-sample} = C_r + C_i$, where C_r

and C_i are the real and imaginary components of the tip-sample capacitance, respectively, $\frac{\Delta f}{f_0}=-\frac{C_r}{2C}$, $\Delta\left(\frac{1}{Q}\right)=-\left(\frac{1}{Q_0}+\frac{2C_i}{C_r}\right)\frac{\Delta f}{f_0}$, $\Delta f=f_r-f_0$, $\Delta\left(\frac{1}{Q}\right)=\frac{1}{Q}-\frac{1}{Q_0}$, and f_0 and Q_0 are the unloaded resonant frequency and quality factor, respectively.

11. (withdrawn): A method for using a scanning evanescent microwave probe to determine electrical properties of a sample, said probe having a tip extending from a coaxial or transmission line resonator, comprising:

correlating tip-sample distance, electrical impedance and their derivatives with respect to an external modulation field, with tip-sample equivalent complex capacitance.

12. (withdrawn): A method as recited in claim 11, wherein said correlating comprises using distribution of charge or electric field with tip-sample geometry solved under a quasi-static approximation.

13. (withdrawn): A method as recited in claim 12, wherein said quasi-static approximation is obtained by finite element analysis of electromagnetic field configuration.

14. (withdrawn): A method as recited in claim 13, wherein said quasi-static approximation is obtained with an approximation of a metal sphere to model tip geometry.

15. (withdrawn): A method as recited in claim 13, wherein said quasi-static approximation is obtained with an approximation of a conic section to model tip geometry.

16. (withdrawn): A method as recited in claim 12, wherein said quasi-static approximation is obtained by an image charge method and expressed in an analytical format.

17. (withdrawn): A method as recited in claim 16, wherein said quasi-static approximation is obtained with an approximation of a metal sphere to model tip geometry.

18. (withdrawn): A method as recited in claim 16, wherein said quasi-static approximation is obtained with an approximation of a conic section to model tip geometry.

19. (withdrawn): A method as recited in claim 13, 14, 15, 16, 17 or 18, wherein said quasi-static approximation is obtained using infinite sample thickness.

20. (withdrawn): A method as recited in claim 13, 14, 15, 16, 17 or 18, wherein said quasi-static approximation is obtained using a finite sample thickness.

21. (withdrawn): A method as recited in claim 13, 14, 15, 16, 17 or 18, wherein said quasi-static approximation is obtained using a multi-layered sample structure.

22. (previously presented): A method for measuring electrical impedance of a sample using a probe having a tip, comprising:

measuring interaction between said tip and said sample without contacting said sample with said tip; and

deriving electrical impedance from said tip-sample interaction.

23. (previously presented): A method as recited in claim 22, wherein said probe comprises a scanning evanescent microwave probe having a tip extending from a coaxial or transmission line resonator.

24. (previously presented): A method as recited in claim 22, wherein said measurements of electrical impedance are selected from the group consisting essentially of quantitative and qualitative measurements.

25. (previously presented): A method as recited in claim 22, wherein said electrical impedance comprises complex dielectric constant and conductivity of said sample.

26. (previously presented): A method as recited in claim 22, wherein said sample comprises a material selected from the group consisting essentially of dielectric insulators, semiconductors, metallic conductors and superconductors.

27. (previously presented): A method as recited in claim 22, wherein said sample comprises a multi-layered material.

28. (previously presented): A method as recited in claim 27, wherein said sample comprises a material selected from the group consisting essentially of dielectric insulators, semiconductors, metallic conductors and superconductors.

29. (previously presented): A method as recited in claim 22, wherein said tip-sample interaction is measured with a modulated external field applied to said sample.

30. (previously presented): A method as recited in claim 29, further comprising detecting the derivatives of the resonant frequency or phase, quality factor or amplitude

of said probe with respect to said external field modulation using lock-in amplifier having an operating frequency coherent with the modulating frequency.

31. (previously presented): A method as recited in claim 22, wherein said tip-sample interaction is measured with modulation of tip-sample distance.

32. (previously presented): A method as recited in claim 31, further comprising modulating said tip-sample distance with a piezoelectric nano-positioning device.

33. (previously presented): A method as recited in claim 31, further comprising:

measuring said tip-sample interaction with a lock-in amplifier having an operating frequency coherent with the modulating frequency driving said nano-positioning device.

34. (previously presented): A method as recited in claim 31, further comprising:

determining a reference zero point of said tip-sample distance by the maximum amplitude of the derivative of resonant frequency or phase of said probe as said tip approaches the sample surface.

35. (previously presented): A method as recited in claim 31, further comprising:

determining a reference zero point of said tip-sample distance by the curve fitting of the derivative of resonant frequency or phase of said probe with respect to tip-sample distance modulation as said tip approaches the sample surface.

36. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by keeping tip-sample distance constant and calibrating with standard samples.

37. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by keeping resonant frequency constant and calibrating with standard samples.

38. (previously presented): A method as recited in claim 22, further comprising:

keeping the derivative of resonant frequency with respect to tip-sample distance modulation or external field modulation constant; and

calibrating with standard samples;

wherein a physical characteristic of said sample is determined.

39. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by curve fitting of resonant frequency or phase of said probe as said tip approaches said sample.

40. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by curve fitting of derivatives of resonant frequency or phase of said probe with respect to external modulation field as said tip approaches said sample.

41. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by curve fitting of quality factor or amplitude of said probe as said tip approaches said sample.

42. (previously presented): A method as recited in claim 22, further comprising:

determining a physical characteristic of said sample by curve fitting of derivatives of quality factor or amplitude of said probe with respect to external modulation field as said tip approaches said sample.

43. (previously presented): A method as recited in claim 29, wherein said external field comprises a bias electric field.

44. (previously presented): A method as recited in claim 36, 37, 38, 39, 40, 41 or 42, further comprising obtaining the nonlinear complex dielectric constant of said sample with electric field modulation.

45. (previously presented): A method as recited in claim 29, wherein said external field comprises a magnetic field.

46. (previously presented): A method as recited in claim 36, 37, 38, 39, 40, 41 or 42, further comprising obtaining a physical characteristic of said sample with magnetic field modulation.

47. (previously presented): A method as recited in claim 29, wherein said modulated external field comprises optical modulation.

48. (previously presented): A method as recited in claim 47, wherein said optical modulation is achieved by a laser having a characteristic photon energy above the semiconductor sample's carrier excitation energy.

49. (previously presented): A method as recited in claim 36, 37, 38, 39, 40, 41 or 42, further comprising obtaining a physical characteristic of said sample with optical modulation.

50. (previously presented): A method as recited in claim 49, further comprising obtaining a physical characteristic of said semiconductor selected from the group

consisting essentially of photoconductivity, dopant level, junction depth, junction profile, ion implant flux level, and annealing temperature.

51. (previously presented): A method as recited in claim 47, wherein said optical modulation is achieved by a laser having a characteristic photon energy in infrared region; and

wherein said sample is heated by said laser.

52. (previously presented): A method as recited in claim 36, 37, 38, 39, 40, 41 or 42, further comprising obtaining a physical characteristic of said sample with heat modulation.

53. (previously presented): A method for using a scanning evanescent microwave probe to determine electrical properties of a sample, said probe having a tip extending from a coaxial or transmission line resonator, comprising:

measuring interaction between said tip and said sample without contacting said sample with said tip; and

determining electrical properties of said sample from said interaction measurement.